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REMARKS

Pending Claims:

Claims 1-47 are currently pending in the present application. Reconsideration of claims 1-9, 11-13, 16-31, 34-36, 38-45, and 47 in light of the following remarks is respectfully requested.

Allowable Subject Matter:

The Applicant acknowledges with appreciation the Examiner's statement made in page 11, section 6 of the Office Action dated December 20, 2005 that claims 10, 14-15, 32-33, 37 and 46 are allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Rejections under 35 U.S.C. §102(b):

Claims 1-5, 7-9, 11-13, 16-22, 24-28, 31, 34-36, 38-39, 41-45, and 47 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent 6,296,742 to Kouznetsov (hereinafter "Kouznetsov").

To anticipate a claim under 35 U.S.C. §102, a single reference must teach every aspect of the claimed invention either explicitly or implicitly. Any feature not directly taught by the reference must be inherently present in the reference. Thus, a claim is anticipated by a reference only if each and every element of the claim is described, either expressly or inherently, in a single prior art reference.

Independent Claim 1 and Dependent Claims 2-5, 7-9, 11-13, and 16-20

The Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 1. Claim 1 recites a pulsed power supply that generates a multi-stage voltage pulse comprising: (1) a low-power stage including a first peak voltage having a magnitude and a rise time that is sufficient to generate a weakly-ionized plasma from the feed gas; and (2) a transient stage including a second peak voltage having a magnitude and a rise time that is sufficient to shift an electron energy distribution in the weakly-ionized plasma to higher

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energies that increase an ionization rate which results in a rapid increase in electron density and a formation of a strongly-ionized plasma.

In summary, the Office Action states that Kouznetsov discloses a pulsed power supply that generates the claimed multi-stage voltage pulse. The Applicant respectfully submits that the arguments made in the Office Action comparing Kouznetsov FIG. 1 to the claimed multi-stage voltage pulse are incorrect and that there is no teaching or suggestion in Kouznetsov of generating the claimed multi-step voltage pulse comprising the low-power stage and the transient stage. Kouznetsov FIG. 1 illustrates a diagram of electrical discharge voltage as a function of the current density that results from the application of the single-step voltage pulse shown in Kouznetsov FIG. 8. Kouznetsov FIG. 1 can not be directly compared with FIGS. 3-8 of the present specification that illustrate diagrams of power supply output voltage, current and power as a function of time. Furthermore, the power supply described in Kouznetsov is specifically designed and operated to produce an arc discharge. In contrast, the claimed pulsed power supply is operated so as to prevent the formation of an arc discharge.

The Office Action includes a copy of FIG. 1 of Kouznetsov and refers to this figure when arguing that Kouznetsov discloses a pulsed power supply that generates the claimed multi-stage voltage pulse. The Applicant respectfully submits that the comparison made in the Office Action between the diagram in Kouznetsov FIG. 1 and the claimed multi-stage voltage pulse is not correct and is not supported by the text of Kouznetsov. FIG. 1 of Kouznetsov is a diagram of voltage as a function of the current density for an electrical discharge between the anode and the cathode and is not a diagram of the voltage generated by the power supply as a function of time, such as the diagrams presented in FIGS. 3-8 of the present specification that are used to illustrate the claimed invention.

A proper comparison of the method of generating a plasma described in Kouznetsov and the claimed multi-stage voltage pulse can be made by referring to Kouznetsov FIG. 8. Kouznetsov FIG. 8 illustrates the output voltage delivered from the Kouznetsov power supply as a function of time. According to Kouznetsov, the output voltage rises very fast, typically during a time period of at most a few microseconds, to a single peak value of a few kilovolts. Then the output voltage decreases to a level, which is determined by a voltage associated with the fully

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ionized plasma in crossing electric and magnetic fields. See Kouznetsov, column 10 lines 29-37.

The voltage generated by the power supply described in Kouznetsov that is shown in Kouznetsov FIG. 8 clearly illustrates a single-step monotonically increasing voltage pulse with a single rise time. Kouznetsov does not teach or suggest a multi-stage voltage pulse comprising two distinct rise times. Thus, Kouznetsov does not teach or suggest a multi-stage voltage pulse having a first peak voltage and rise time and a second peak voltage and rise time, which is claimed in independent claim 1 and which is illustrated in FIGS. 3-8 of the present specification.

In addition, the Applicant believes that the rise time of the single-step voltage pulse generated by the Kouznetsov power supply is not controlled and chosen to generate a weakly-ionized plasma as claimed in independent claim 1. Instead, Kouznetsov describes a power supply that is designed and operated to provide pulses in such a way that so much power is developed in each pulse, that in the application of such a pulse, for a very short time during the start of the pulse, the state of the gas located at the region in which the electrons are trapped by the magnetic field will very rapidly reach a fully ionized state. See Kouznetsov, column 4, lines 17-26. Thus, the Applicant believes that the power supply described in Kouznetsov is designed to produce a very fast rise time that is not controlled as claimed in independent claim 1 to generate a weakly-ionized plasma and then to achieve a rapid increase in electron density and a formation of a strongly-ionized plasma.

Furthermore, the single-step voltage pulse generated by the Kouznetsov power supply has such a fast uncontrolled rise time that it causes an arc discharge. Kouznetsov FIG. 1 illustrates a diagram of voltage as a function of current density for an electrical discharge that shows the plasma states that are present during the very short time from the onset of the single-step voltage pulse generated by the power supply to the time that a fully ionized plasma is achieved. See Kouznetsov, column 10 lines 38-49. The plasma states include a dark current region, a glow discharge region, an arc discharge region, and a fully ionized region. See, for example, Kouznetsov, column 6, line 38 to column 7, line 21.

Thus, the single-step voltage pulse generated by the Kouznetsov power supply is chosen to achieve an arc discharge state that transitions into a fully ionized region. In contrast, the claimed multi-stage voltage pulse comprising the low-power stage and the transient stage does

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not produce an arc discharge. As described in paragraph 28 of the present specification, arcing is undesirable because it can damage the anode and cathode assembly and can contaminate the wafer or work piece being processed. In one embodiment of the present invention, the circuitry of the pulse supply limits the plasma discharge current up to a certain level, and if this limit is exceeded, the voltage generated by the power supply drops for a certain period of time. In addition as described in paragraph 131 of the present invention, the geometry of the gap can be chosen to minimize the probability of arcing.

In view of the above remarks, the Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 1, either expressly or inherently. Therefore, the Applicant submits that Kouznetsov does not anticipate independent claim 1 under 35 U.S.C. § 102(b). Thus, the Applicant submits that independent claim 1 is allowable. The Applicant also submits that dependent claims 2-5, 7-9, 11-13, and 16-20 are allowable as depending from an allowable base claim.

Independent Claim 21 and Dependent Claims 22, 24-28, 31, 34-36

The Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 21. Independent claim 21 recites a method of generating a strongly-ionized plasma that includes the steps of (1) generating a weakly-ionized plasma by applying a first voltage between the anode and the cathode assembly having a magnitude and a rise time that is sufficient to ignite the feed gas; and (2) generating a strongly-ionized plasma from the weakly-ionized plasma by applying a second voltage between the anode and the cathode assembly, the second voltage having a magnitude and a rise time that is sufficient to shift an electron energy distribution in the weakly-ionized plasma to higher energies that increase an ionization rate which results in a rapid increase in electron density and a formation of the strongly-ionized plasma.

As stated in connection with the rejection of independent claim 1, there is no teaching or suggestion in Kouznetsov of generating a multi-step voltage pulse with a first magnitude and rise time that generates a weakly-ionized plasma and a second magnitude and rise time that generates a strongly-ionized plasma from the weakly-ionized plasma. In contrast Kouznetsov teaches

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generating a single-step voltage pulse that has a fast uncontrolled rise time that causes an arc discharge.

In view of the above remarks, the Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 21, either expressly or inherently. Therefore, the Applicant submits that Kouznetsov does not anticipate independent claim 21 under 35 U.S.C. §102(b). Thus, the Applicant submits that independent claim 21 is allowable. The Applicant also submits that dependent claims 22, 24-28, 31, 34-36 are allowable as depending from an allowable base claim.

Independent Claim 38 and Dependent Claims 39, and 41-45

The Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 38. Independent claim 38 recites a method of generating a strongly-ionized plasma that includes applying a voltage pulse between the anode and the cathode assembly with a first peak voltage having a magnitude and a rise time that ignites an initial plasma from the feed gas and a second peak voltage having a magnitude and a rise time that results in a rapid increase in electron density and a formation of a strongly-ionized plasma that is sustained for greater than 200µsec.

As stated in connection with the rejection of independent claim 1, there is no teaching or suggestion in Kouznetsov of generating a multi-step voltage pulse with a first magnitude and rise time that generates a weakly-ionized plasma and a second magnitude and rise time that generates a strongly-ionized plasma from the weakly-ionized plasma. In contrast Kouznetsov teaches generating a single-step voltage pulse that has a fast uncontrolled rise time that causes an arc discharge.

In view of the above remarks, the Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 38, either expressly or inherently. Therefore, the Applicant submits that Kouznetsov does not anticipate independent claim 38 under 35 U.S.C. §102(b). Thus, the Applicant submits that independent claim 38 is allowable. The Applicant also submits that dependent claims 39 and 41-45 are allowable as depending from an allowable base claim.

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Independent Claim 47

The Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 47. Independent claim 47 recites an apparatus for generating a strongly-ionized plasma that includes (1) a means for generating a weakly-ionized plasma from the feed gas; (2) a means for shifting an electron energy distribution in the weakly-ionized plasma to higher energies that increase an ionization rate which results in a rapid increase in electron density and a formation of the strongly-ionized plasma from the weakly-ionized plasma; and (3) a means for sustaining the strongly-ionized plasma for greater than 200 μ sec.

The Office Action refers to Kouznetsov FIG. 1 and states that Kouznetsov discloses a method of applying a voltage pulse between an anode and a cathode comprising a first peak voltage sufficient to ignite an initial plasma from the feed gas; and a second peak voltage having a magnitude and a rise time that is sufficient to shift an electron energy distribution in the initial plasma to higher energies that increase an ionization rate resulting in a rapid increase in electron density and a formation of the strongly-ionized plasma. As stated in connection with the rejection of independent claim 1, there is no teaching or suggestion in Kouznetsov of generating a multi-step voltage pulse that generates a weakly-ionized plasma and then generates a strongly-ionized plasma from the weakly-ionized plasma. In contrast, Kouznetsov teaches generating a single-step voltage pulse that has a fast uncontrolled rise time that causes an arc discharge.

In view of the above remarks, the Applicant respectfully submits that Kouznetsov does not describe each and every element of independent claim 47, either expressly or inherently. Therefore, the Applicant submits that Kouznetsov does not anticipate independent claim 47 under 35 U.S.C. §102(b). Thus, the Applicant submits that independent claim 47 is allowable.

Rejections under 35 U.S.C. §103(a)

Claims 6, 23, 29-30, and 40 are rejected under 35 U.S.C. §103(a). Claim 6 is rejected under 35 U.S.C. §103(a) as being unpatentable over Kouznetsov in view of U.S. Patent Number 5,844,195 to Fairbairn. Claims 23 and 40 are rejected under 35 U.S.C. §103(a) as being unpatentable over Kouznetsov in view of U.S. Published Patent Application Number 2005/0173239 to Somekh. Claims 29 and 30 are rejected under 35 U.S.C. §103(a) as being

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unpatentable over Kouznetsov in view of "Bifurcation and Chaos in Weakly Ionized Magneto-Plasmas," Lin, Chinese Journal of Physics, Vol. 29, No. 4, August 1991.

In view of the above remarks, the Applicant submits that independent claims 1, 21, and 38 are not obvious under 35 U.S.C. §103(a) in view of the above references alone or in combination because none of these references teach or suggest generating a multi-step voltage pulse with a first magnitude and rise time that generates a weakly-ionized plasma and a second magnitude and rise time that generates a strongly-ionized plasma from the weakly-ionized plasma.

CONCLUSION

Reconsideration of claims 1-47 is respectfully requested in light of above arguments.


The Commissioner is hereby authorized to charge any proper fees to Attorney's Deposit Account No. 501211.

If, in the Examiner's opinion, a telephonic interview would expedite prosecution of the present application, the undersigned attorney would welcome the opportunity to discuss any outstanding issues, and to work with the Examiner toward placing the application in condition for allowance.

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Respectfully submitted,



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